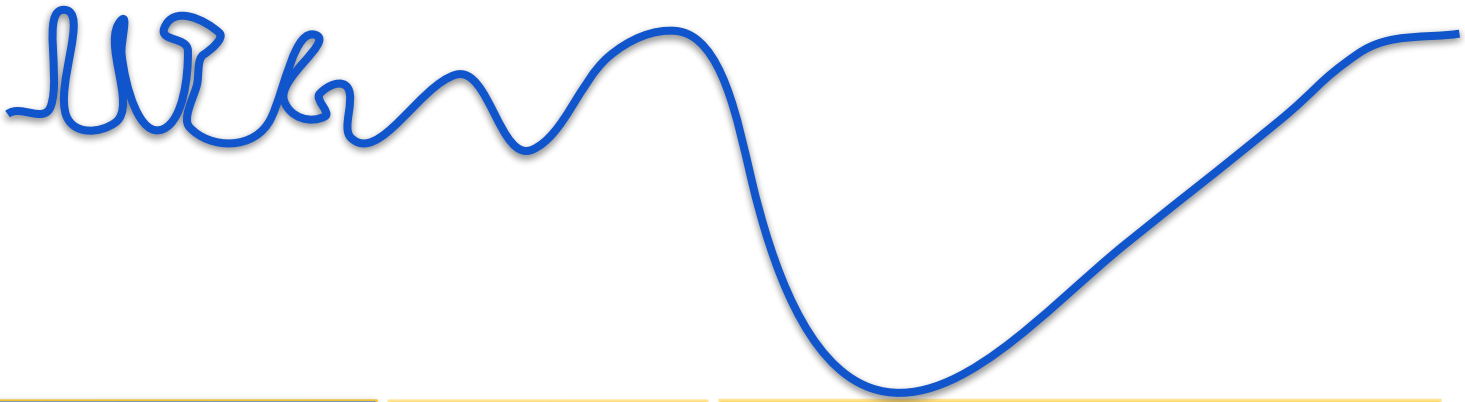
Computing with Signals



DA 623

Jan - May 2023

IIT Guwahati

Instructors: Neeraj Sharma

Lecture-01

Signal - what’s that?

- Lets’ hear your thoughts - what is signal for you?

Signal - what’s that?

- Lets’ hear your thoughts - what is signal for you?

Signal - what's that?

- Lets' hear your thoughts - what is signal for you?
  - something varying with time
  - something that is output from a physical system
  - something varying over space
  - something that conveys information
  - …. and more!

Signal - what's that?

- Lets' hear your thoughts - what is signal for you?
  - something varying with time
  - something that is output from a physical system
  - something varying over space
  - something that conveys information

Signal

- a signal, represented as a function of one or more variables, may be defined as an observable change in a quantifiable entity [1].

(conveys information)

Nice! we are all on same page!

[1] Pragnan Chakravorty, "What is a signal?", Lecture Notes, IEEE Signal Proc. Magazine, 2018

About Me

- Assistant Professor
  - Mehta Family School of Data Science and AI, IIT G
  - `https://neerajww.github.io/`
- Before this
  - Schooling in Bhubaneswar
  - BTech from CET, Bhubaneswar
  - Masters, PhD, IISc Bangalore
  - Postdocs - IISc, Carnegie Mellon, Fraunhofer Audio Labs
- Learning, and contributing (a reason for this course)

What’s going on Earth?

About Google Books
• Overview

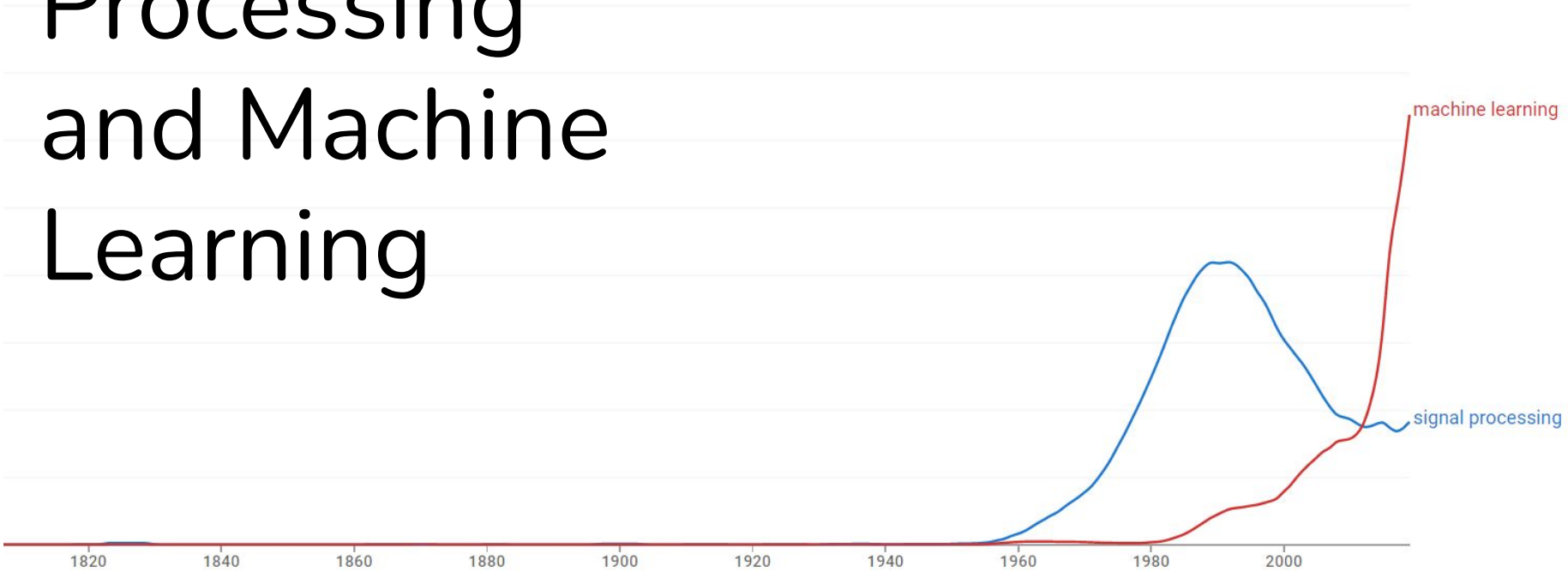
Google Books Library Project – An enhanced card catalog of the world's books

Google Books Ngram Viewer

signal processing, machine learning

1800 - 2019 | English (2019) | Case-Insensitive | Smoothing

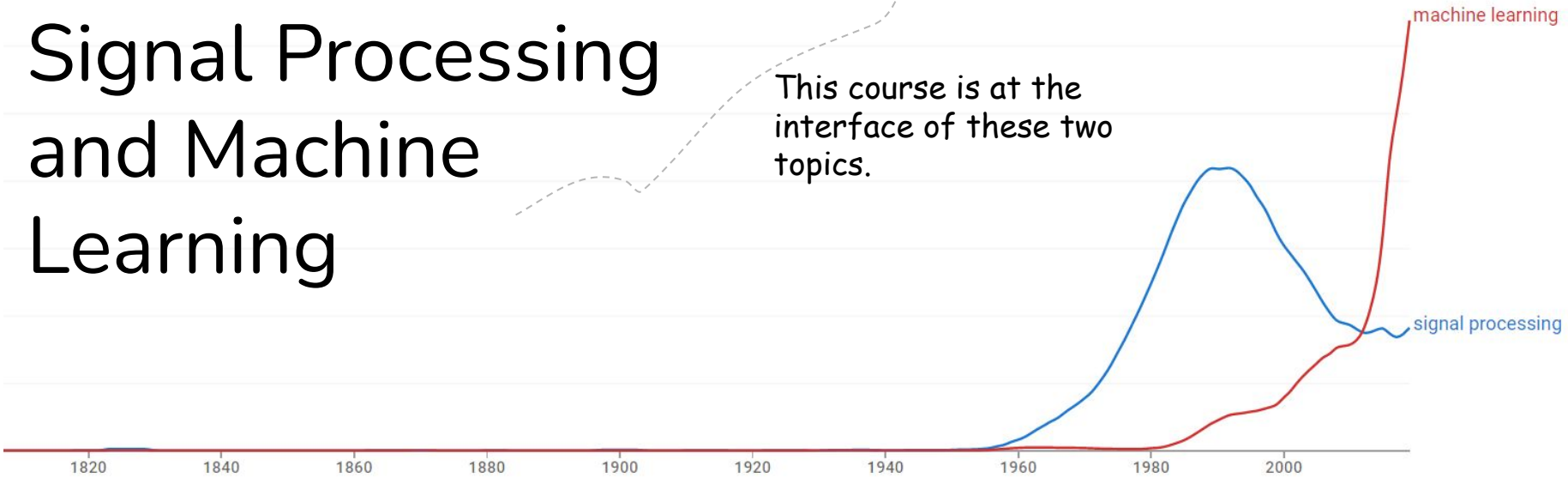
Signal Processing and Machine Learning

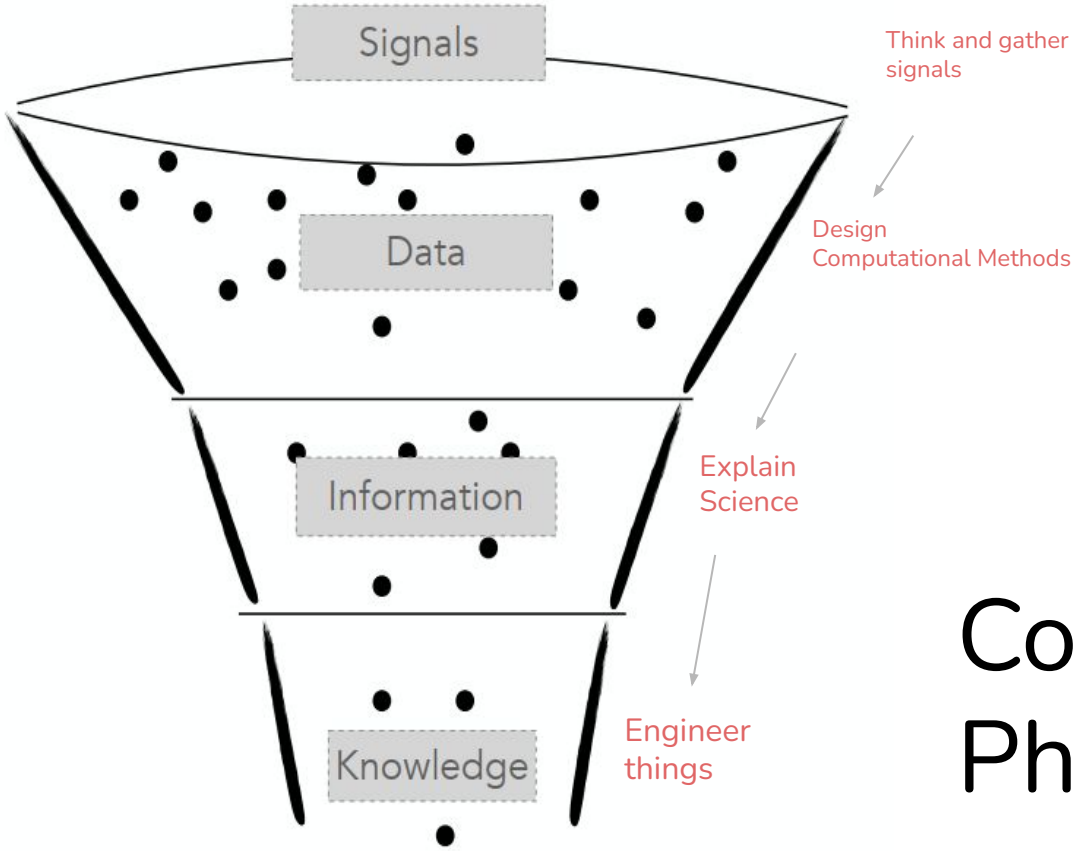


Computing with Signals

Signal Processing and Machine Learning

This course is at the interface of these two topics.





Course Philosophy

Syllabus

Part-1: Foundations of Signal Processing

1. Introduction to (recorded) signals
2. Human perception of signals: hearing, vision and brain
3. Signal representations: continuous, Fourier series, Taylor series, sampling, discrete-time, and basis functions
4. DSP Methods: LTI system, convolution, DFT, DCT

Part-2: Advance Signal Processing

1. Time-frequency analysis
2. Spectral Estimation, Filtering, artifacts, and Kalman Filtering
3. Compressive Sensing

Part-3: Machine Learning on Signals

1. Dictionary Learning
2. Dimensionality Reduction: Concept and approaches
3. Modelling: What is a model? Why use a model? What are types of models?
4. Model fitting using deterministic and probabilistic approaches
5. Classifiers: Logistic regression to DNNs, and ending at CNNs

Part-4: Hands-on Development & Research

1. Project: Pursued by students - Runs through out the course - Topics: Theory and Applications of SP and ML
2. Paper: Pursued by students - Paper Reading and Understanding - Critiquing through Presentation

We will have a course website: https://neerajww.github.io/da623/ and MS Teams

More on logistics - grading, projects, paper

- Coming soon after first 3 classes

We have a course website: https://neerajww.github.io/da623/ and MS Teams